CLAIMS

I claim:

1. A temperature control system for an electronic component, the system comprising:

a Peltier module comprising a cooling side that absorbs heat when electric current flows through the Peltier module in a first direction;

a Peltier driver comprising a control input capable of receiving control signals, the Peltier driver being capable of providing to the Peltier module a current regulated by the control signals;

a temperature sensor that generates indications of temperature of the electronic component;

a temperature reader coupled to the temperature sensor to receive the indications of temperature from the temperature sensor, the temperature reader being capable of interpreting the indications of temperature and generating temperature signals from the temperature indications;

a feedback control circuit coupled to the temperature reader to receive the temperature signals from the temperature reader, the feedback control circuit comprising a control output coupled to the control input of the Peltier driver to provide the control signals regulating the current to the Peltier module.

2. A temperature control system in accordance with claim 1, further comprising a fan capable of blowing air to reduce temperature of the electronic component.

3. A temperature control system in accordance with claim 2, wherein the fan is capable of blowing air at the electronic component.

4. A temperature control system in accordance with claim 2, further comprising a heat sink attached to the electronic component, wherein:

the fan is capable of blowing air at the heat sink; and

the cooling side of the Peltier module is attached to the heat sink.

5. A temperature control system in accordance with claim 2, wherein the fan blows the air towards the cooling side of the Peltier module and at the electronic component, and the air passes near the cooling side of the Peltier module before the air reaches the electronic component, so that the cooling side of the Peltier module absorbs heat from the air before the air reaches the electronic component.

6. A temperature control system in accordance with claim 2, further comprising a heat sink attached to the electronic component, wherein the fan blows the air towards the cooling side of the Peltier module and at the heat sink, and the air passes near the cooling side of the Peltier module before the air reaches the heat sink, so that the cooling side of the Peltier module absorbs heat from the air before the air reaches the heat sink.

7. A temperature control system in accordance with claim 1, further comprising a fan capable of blowing air, wherein:

the Peltier module further comprises a warming side that releases heat when a current flows through the Peltier module in the first direction; and

the fan blows the air at the warming side of the Peltier module to remove heat from the warming side.

8. A temperature control system in accordance with claim 1, wherein the Peltier module comprises a pair of Antimony-Bismuth thermocouples.

9. A temperature control system in accordance with claim 1, wherein the Peltier module comprises Bismuth Telluride doped with Selenium and Antimony.

10. A temperature control system in accordance with claim 1, wherein:

the feedback control circuit provides a first control signal of the signals regulating the current to the Peltier module in response to receiving a first temperature signal of the temperature signals, the first temperature signal signifying a temperature above a preset high temperature limit; and

the first control signal directs the Peltier driver to provide a first current to the Peltier module, the first current flowing in the first direction and causing the cooling side to absorb heat from the electronic component.

11. A temperature control system in accordance with claim 10, wherein:

the cooling side of the Peltier module releases heat when the current flows through the Peltier module in a second direction;

the feedback control circuit provides a second control signal of the signals regulating the current to the Peltier module in response to receiving a second temperature signal of the temperature signals, the second temperature signal signifying a temperature below a preset low temperature limit; and

the second control signal directs the Peltier driver to provide a second current to the Peltier module, the second current flowing in the second direction and causing the cooling side to release heat.

12. A temperature control system in accordance with claim 10, further comprising a relative humidity sensor that provides relative humidity measurements to the feedback control circuit;

wherein:

the cooling side of the Peltier module releases heat when the current flows through the Peltier module in a second direction;

the feedback control circuit provides a second control signal of the signals regulating the current to the Peltier module in response to receiving a relative humidity measurement over a preset high humidity limit; and

the second control signal directs the Peltier driver to provide a second current to the Peltier module, the second current flowing in the second direction and causing the cooling side to release heat.

13. A temperature control system in accordance with claim 1, wherein the Peltier module comprises two pairs of cascaded thermocouples.

14. A temperature control system in accordance with claim 1, wherein the temperature sensor is in direct contact with the electronic component.

15. A temperature control system in accordance with claim 14, wherein the Peltier module is in direct contact with the electronic component.

16. A temperature control system in accordance with claim 14, wherein the electronic component comprises an upper portion, and the Peltier module is in direct contact with the upper portion.

17. A temperature control system in accordance with claim 14, further comprising a heat sink attached to the electronic component, wherein the Peltier module is in direct contact with the heat sink.

18. A temperature control system in accordance with claim 1, wherein the temperature sensor comprises a thermistor with resistance varying over temperature.

19. A temperature control system in accordance with claim 18, wherein:

the temperature reader comprises a voltage comparison device, the voltage comparison device comprises a pair of inputs and an output, the output of the voltage comparison device assuming a first state when a first voltage at a first input of the pair of inputs is higher than a second voltage at a second input of the pair of inputs, the output of the voltage comparison device assuming a second state when the first voltage is lower than the second voltage; and

the first voltage or the second voltage varies with the resistance of the thermistor.

20. A temperature control system in accordance with claim 19, wherein:

the Peltier driver comprises a drive source; and

the feedback control system comprises a switch that couples the drive source to the Peltier module and uncouples the drive source from the Peltier module depending on the state of the output of the voltage comparison device.

21. A temperature control system in accordance with claim 20, wherein the drive source is a voltage source.

22. A temperature control system in accordance with claim 20, wherein the drive source is a current source.

23. A temperature control system in accordance with claim 18, wherein:

the temperature reader comprises:

a voltage comparison device, the voltage comparison device comprises a plus input, a minus input, and an output, the output of the voltage comparison device assuming an ON state when a first voltage at the plus input is higher than a second voltage at the minus second input, the output of the voltage comparison device assuming an OFF state when the second voltage is higher than the first voltage;

a resistor coupled between the output and the plus input of the voltage comparison device to add hysteresis to the response of the temperature reader; and

a voltage at an input of the voltage comparison device varies with the resistance of the thermistor.

24. A temperature control system in accordance with claim 23, wherein:

the feedback control circuit comprises an integrator that integrates the state of the output of the voltage comparison device to produce an integrated feedback control signal; and

the Peltier driver comprises a pulse-width modulated power supply coupled to the feedback control circuit to receive the integrated feedback control signal and to drive the Peltier module with power pulses of duty cycle modulated by the integrated feedback control signal.

25. A temperature control system in accordance with claim 10,

wherein:

the Peltier driver comprises a drive source; and

the electronic component is installed in a vehicle, the vehicle comprising a battery;

the system further comprises:

a power supply circuit providing power to the drive source; and

a battery monitor supervising the battery of the vehicle and turning off the power supply when the battery discharges to a predetermined state.

26. A temperature control system in accordance with claim 10,

wherein:

the Peltier driver comprises a drive source; and

the electronic component is a loudspeaker installed in a vehicle, the vehicle comprising a battery, the loudspeaker receiving an audio signal;

the system further comprises a power supply circuit generating power for the drive source from the audio signal.

27. A temperature control system for an audio component, the temperature control system comprising:

a first thermocouple junction that absorbs heat when electric current flows through the first thermocouple junction in a first direction;

a driver circuit coupled to the first thermocouple junction to provide a temperature controlled current through the junction, the driver circuit comprising a control input capable of receiving a control signal that regulates the temperature controlled current;

a temperature sensor that generates indications of temperature of the audio component; and

a controller comprising:

an input unit coupled to the temperature sensor, the input unit being capable of reading the indications of temperature of the audio component;

a control output coupled to the control input of the driver circuit to send the control signal to the control input of the driver circuit; and

a processor coupled to the input unit and to the control output, the processor being capable of interpreting the indications of temperature of the audio component and

varying the control signal so that the first thermocouple junction absorbs heat when the temperature sensor indicates that temperature of the audio component exceeds a first parameter, and so that the first thermocouple does not absorb heat when the temperature sensor indicates that the audio component does not exceed a second parameter.

28 A temperature control system according to claim 27, wherein the processor comprises a digital central processing unit.

29. A temperature control system according to claim 28, wherein the input unit comprises an analog-to-digital converter that digitizes the indications of temperature to provide digitized temperature readings to the digital central processing unit.

30. A temperature control system according to claim 29, wherein the audio component is installed in a vehicle, the vehicle comprises a source of electric energy, the temperature control system being coupled to the source of electric energy to receive energy for the operation of the system from the source of electric energy.

31. A temperature control system according to claim 30, wherein the temperature sensor comprises a thermistor.

32. A temperature control system according to claim 31, wherein the driver circuit comprises a drive source.

33. A temperature control system according to claim 32, wherein the driver circuit further comprises a switch controlled by the control signal, the switch coupling the drive source to the first thermocouple junction and uncoupling the drive source from the first thermocouple junction depending on the state of the control signal.

34. A temperature control system according to claim 28, wherein the temperature sensor comprises a digital connection, the temperature sensor being coupled to the controller and

being readable by the processor through the digital connection, the temperature sensor being capable of providing the indications of temperature to the processor through the digital connection.

35. A temperature control system in accordance with claim 30, further comprising a fan for blowing air at the audio component.

36. A temperature control system in accordance with claim 30, further comprising:
a heat sink attached to the audio component; and
a fan for blowing air at the heat sink;
wherein the first thermocouple is attached to the heat sink.

37. A temperature control system in accordance with claim 30, further comprising a fan blowing air towards the first thermocouple and the at audio component, wherein the air passes near the first thermocouple before the air reaches the audio component, so that the first thermocouple absorbs heat from the air before the air reaches the audio component.

38. A temperature control system in accordance with claim 30, further comprising:
a second thermocouple junction in series with the first thermocouple junction, the second thermocouple junction releasing heat when electric current flows trough the second thermocouple in the first direction; and
a fan blowing air at the second thermocouple junction so as to remove heat from the second thermocouple.

39. A temperature control system in accordance with claim 30, wherein:
the driver circuit comprises a drive source; and
the audio component comprises a loudspeaker installed in a vehicle, the vehicle comprising a battery, the loudspeaker receiving an audio signal;
the system further comprises:
a power supply circuit generating power for the drive source from the audio signal.

40. A temperature control system in accordance with claim 30,
wherein:
the driver circuit comprises a drive source; and
the audio component is installed in a vehicle, the vehicle comprising a battery;
the system further comprises:
a power supply circuit providing power to the drive source; and
a battery monitor supervising the battery of the vehicle and turning off the power supply circuit when the battery discharges to a predetermined state.

41. A temperature control system in accordance with claim 30, wherein the first parameter is identical to the second parameter.

42. A temperature control system for an audio component, the temperature control system comprising:
a first thermocouple junction that absorbs heat when electric current flows through the first thermocouple junction in a first direction;
a variable driver circuit coupled to the first thermocouple junction to provide a temperature controlled current through the first junction, the variable driver circuit comprising a control input capable of receiving a control signal that regulates the temperature controlled current;
a temperature sensor that generates indications of temperature of the audio component; and
a controller comprising:
an input unit coupled to the temperature sensor, the input unit being capable of reading the indications of temperature of the audio component;
a digital-to-analog converter comprising a control output coupled to the control input of the variable driver circuit, the digital-to-analog converter being capable of generating the control signal; and
a digital processor coupled to the input unit and to the digital-to-analog converter, the digital processor being capable of interpreting the indications of temperature of the audio component and instructing the digital-to-analog converter to vary the

control signal so that the first thermocouple junction absorbs heat when the temperature sensor indicates that temperature of the audio component exceeds a first parameter, and so that the first thermocouple does not absorb heat when the temperature sensor indicates that temperature of the audio component does not exceed a second parameter.

43. A temperature control system according to claim 42, wherein the input unit comprises an analog-to-digital converter that digitizes the indications of temperature to provide digitized temperature readings to the digital central processing unit.

44. A temperature control system according to claim 43, wherein the audio component is installed in a vehicle, the vehicle comprising a source of electric energy, the temperature control system being coupled to the source of electric energy to receive energy for the operation of the system from the source of electric energy.

45. A temperature control system according to claim 44, wherein the temperature sensor comprises a thermistor.

46. A temperature control system according to claim 45, wherein the variable driver circuit comprises a drive source.

47. A temperature control system according to claim 46, wherein the variable driver circuit comprises a pulse-width modulated power supply generating pulses of the temperature controlled current through the first thermocouple, the pulses of the temperature controlled current being of variable duty cycle, the duty cycle varying with the control signal.

48. A temperature control system according to claim 44, wherein the temperature sensor comprises a digital connection, the temperature sensor being coupled to the controller and readable by the processor through the digital connection, the temperature sensor providing the indications of temperature to the processor through the digital connection.

49. A temperature control system in accordance with claim 44, further comprising a fan capable of blowing air at the audio component.

50. A temperature control system in accordance with claim 44, further comprising:
a heat sink attached to the audio component; and
a fan capable of blowing air at the heat sink;
wherein the first thermocouple is attached to the heat sink.

51. A temperature control system in accordance with claim 44, further comprising a fan capable of blowing air towards the first thermocouple and at the audio component, wherein the air passes near the first thermocouple before the air reaches the audio component, so that the first thermocouple absorbs heat from the air before the air reaches the audio component.

52. A temperature control system in accordance with claim 44, further comprising:
a second thermocouple junction in series with the first thermocouple junction, the second thermocouple junction releasing heat when electric current flows in the first direction; and
a fan capable of blowing air at the second thermocouple junction so as to remove heat from the second thermocouple.

53. A temperature control system in accordance with claim 44, wherein the first parameter is identical to the second parameter.

54. A cooling system for an audio component of a vehicle, the cooling system comprising:
a Peltier module comprising a cooling side that absorbs heat when electric current flows through the Peltier module in a first direction;
a Peltier driver comprising a control input capable of receiving a control signal, the Peltier driver being coupled to the Peltier module to provide to the Peltier module a current regulated by the control signal;

a temperature sensor that generates indications of temperature of the audio component; and

a feedback mechanism that receives the temperature indications from the temperature sensor and adjusts the control signal to vary the current to the Peltier module to prevent the temperature of the audio component from exceeding a predetermined parameter.

55. A cooling system in accordance with claim 54, further comprising:

a power supply that provides power to the Peltier driver; and

a battery supervisor that provides a discharge signal to the power supply when a battery of the vehicle discharges to a first predetermined state, the discharge signal causing the power supply to stop providing power to the Peltier driver.

56. A cooling system for an audio component, the cooling system comprising:

a Peltier module comprising a cooling side that absorbs heat when electric current flows through the Peltier module;

a driver means for providing to the Peltier module a current regulated by a control signal;

a temperature sensing means for generating indications of temperature of the electronic component; and

a feedback means for varying the control signal in response to the indications of temperature to cause the driver means to provide a temperature controlled current to the Peltier module when the temperature of the audio component exceeds a predetermined parameter.

57. A cooling system for an audio component according to claim 56, further comprising an air blowing means for reducing the temperature of the audio component.

58. A method for controlling temperature of an audio component installed in a vehicle, the method comprising the following steps:

providing a thermocouple junction that absorbs heat dissipated in the audio component when electric current flows through the thermocouple junction in a first direction;

providing an adjustable current to the thermocouple junction;

measuring the temperature of the audio component to obtain temperature measurements;

adjusting the current to the thermocouple junction in response to the temperature measurements so as to cause the thermocouple junction to absorb the heat dissipated in the audio component when the temperature of the audio component exceeds a predetermined parameter.

59. A method in accordance with claim 58, wherein the audio component is a loudspeaker receiving an audio signal, the method further comprising a step of generating the adjustable current from the audio signal.

60. A method in accordance with claim 58, wherein the audio component is a loudspeaker receiving an audio signal, the method further comprising a step for generating the adjustable current from the audio signal.

61. A method in accordance with claim 58, further comprising the steps of:

monitoring a power source of the vehicle;

turning off the current to the thermocouple when the power source discharges to a predetermined state.

62. A cooling system for an audio amplifier of a vehicle, the amplifier comprising a step-up high voltage rail transformer, the cooling system comprising:

a Peltier module comprising a cooling side that absorbs heat when electric current flows through the Peltier module in a first direction;

a Peltier driver comprising a control input capable of receiving a control signal, the Peltier driver being coupled to the Peltier module to provide to the Peltier module a current regulated by the control signal;

a temperature sensor that generates indications of temperature of the audio component;

a feedback mechanism that receives the temperature indications from the temperature sensor and adjusts the control signal to vary the current to the Peltier module to prevent the temperature of the audio component from exceeding a predetermined parameter;

auxiliary windings on the transformer that generate an auxiliary stepped-up AC voltage; and

a power supply that receives the auxiliary stepped-up AC voltage and generates current provided to the Peltier module.

63. A cooling system for an audio amplifier, the amplifier comprising a step-up high voltage rail transformer, the cooling system comprising:

a Peltier module comprising a cooling side that absorbs heat when electric current flows through the Peltier module in a first direction, the cooling side being in contact with the transformer;

a Peltier driver comprising a control input capable of receiving a control signal, the Peltier driver being coupled to the Peltier module to provide to the Peltier module a current regulated by the control signal;

a temperature sensor that generates indications of temperature of the audio component; and

a feedback mechanism that receives the temperature indications from the temperature sensor and adjusts the control signal to vary the current to the Peltier module to prevent the temperature of the audio component from exceeding a predetermined parameter.

64. A cooling system in accordance with claim 63, further comprising a heat sink, wherein:

the Peltier module further comprises a warming side that releases heat when electric current flows through the Peltier module in the first direction; and

the warming side is in contact with the heat sink.

65. A cooling system for an audio amplifier, the amplifier comprising an output stage device, the cooling system comprising:

a Peltier module comprising a cooling side that absorbs heat when electric current flows through the Peltier module in a first direction, the cooling side being in contact with the output stage device;

a Peltier driver comprising a control input capable of receiving a control signal, the Peltier driver being coupled to the Peltier module to provide to the Peltier module a current regulated by the control signal;

a temperature sensor that generates indications of temperature of the audio component; and

a feedback mechanism that receives the temperature indications from the temperature sensor and adjusts the control signal to vary the current to the Peltier module to prevent the temperature of the audio component from exceeding a predetermined parameter.

66. A cooling system in accordance with claim 65, further comprising a heat sink, wherein:

the Peltier module further comprises a warming side that releases heat when electric current flows through the Peltier module in the first direction; and

the warming side is in contact with the heat sink.